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MONTHLY LETTER REPORT  
ON  
IMAGE ANALYSIS III (U)

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1 OCTOBER 1968 TO 1 NOVEMBER 1968

by

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MONTHLY LETTER REPORT  
ON  
IMAGE ANALYSIS III

I. SHADED APERTURE INVESTIGATION

A. THE IDT

The calculation of Wiener shaded apertures for use in the IDT are solely dependent upon the following factors:

1. Magnitude and shape of the Wiener spectrum of the signal
2. Magnitude and shape of the Wiener spectrum of the noise
3. Transfer function of the film in the taking system
4. Transfer function of the lens in the taking system.

As far as sharpening edges, increasing the measured resolution and reducing granularity is concerned, we now have a better feel for what shaded apertures can do.

The targets  manufactured last year were on 3404 film. The lens system they used was nearly diffraction limited (up to 75-90 lines/mm.) This system was used because the optical transfer function was close to that being attained by current operational systems.

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Let us look at the transfer function of the lens and film in their system. 3404 film is known to have a maximum resolution of at least 400 cycles/mm, while our lens system can resolve only 75-90 cycles/mm. Thus, we see our system is not grain limited, but lens limited. Essentially, there is no information past the cutoff of the lens, and Wiener filtering will only serve to smooth out fluctuations due to grain clumps; it will not increase resolution.

Wiener filtering definitely increases resolution and smooths noise when the optical transfer function cuts off beyond the film, as our past experiments have revealed. Since it is of utmost importance to know the system transfer function, we will be measuring the modulation transfer function using edge gradient analysis techniques on the actual photography in question.

It is hoped that we can then, after receiving suitable photography from  demonstrate the usefulness of Wiener shaded apertures on simulated operational system photography.

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## B. THE MICROSCOPE

Several aspects of Wiener filtering in the microscope are being investigated with the aim of improving this procedure. The microscope filtering done to date has been coherent filtering, which has the advantage that a larger class of filters can be realized than in an incoherent system, that is, we are not restricted to filters whose transmission is real and positive everywhere. It now appears, however, that for the specific filtering problems we are interested in, that the filters are realizable in an incoherent imaging system. Such a system would have advantages over the coherent system in that coherent artifacts would be eliminated and the nonlinearity introduced into the coherent system by the detection process would be eliminated. Experiments are now underway to compare the coherent and incoherent systems.

## II. FILM BASE STUDIES

During the past month, a special task was conducted to determine if residual images can exist on film base after the emulsion is removed. This investigation was conducted using both chemical and optical techniques. It was found that if the film is exposed to intense ultraviolet light through the emulsion before the emulsion is removed, then a residual image can be detected in reflected UV light. This residual image was strongest with Estar base film such as 3404. The dynamic range of the residual image was quite poor, and only high contrast binary objects, such as lettering, could be clearly recovered.

Experiments were also conducted to determine if a visible light image could be detected on the film base following a UV exposure through the emulsion. A high contrast Ronchi ruling was used as an object, and attempts to detect an image were made by looking for diffraction orders in an optical transform system. For 3404 film, very weak diffraction orders corresponding to the frequency of the grating could be detected. When an image modulated with a grating was used, however, the image could not be recovered due to the poor signal to noise characteristics. On other types of film base, it was not even possible to detect diffraction orders due to the ruling alone.

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Attempts were also made to recover images by physical development. This proved to be possible in cases where the emulsion was apparently not completely removed, but when the emulsion was completely removed, no effect was observed.

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PROGRESS REPORT NO. 4

PROJECT 6607

Period: October 1 through October 31, 1968

by

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Prepared For

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## Contract Status Report No. 4

PROGRESS DURING THE PERIOD

All test material required for the remainder of the program has been processed and is available for analysis. Resolution readings have been made on the material, and it appears the material is suitable for analysis. The series of material exposed with an  $f$  8 aperture has resolution on the order of 100 l/mm, and the material exposed with an  $f$  16 aperture is around 70 l/mm. No readings were taken during the last period since the processed film was received during the last week of the reporting period.

PROBLEM AREAS

No problem areas now exist, since a comparator is now available for use in reading the material. No further problem is expected in this regard.

WORK PLANNED FOR NEXT PERIOD

The goal for the next period is the complete reading and analysis of the higher resolution set of material. The quarterly report will also be written during the next reporting period.

WORK SCHEDULE

We estimate that at this point the work is one month behind the original schedule.

PERSONNEL

No changes have been made in the personnel assigned to this program.

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PERCENTAGE COMPLETION

100% of Task 1 is completed

Approximately 40% of Task 2 is completed.

Approximately 35% of Task 3 is completed.

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